Table of Contents

X5 Updates

Initial Print Date:3/02 Revision Date:

X5 Updates

Model: X5, X5 4.6 iS

Production: 9/02

Objectives:

After completing this module you should be able to:

- Recognize the components of EHC2
- Locate the EHC2 components
- Understand the operation and diagnose EHC2
- Recognize the X5 4.6iS
- Relate the additions and modification to the 4.6iS

Two Axle Air Suspension

Purpose of the System

The two axle air suspension system (EHC2) offers advantages over the single-axle air suspension with respect to ride comfort and off-road capability.
Lowering the entire body makes it easier to enter, exit, load and unload the vehicle.
The vehicle's off-road capability was improved by providing the possibility for increasing the ground clearance of the body.
The driver can now choose between three different ride levels which can be set with a rocker switch, as required. Automatic ride-height control for payload compensation and automatic inclination compensation continue to be fitted.

Deficits of the old system

The automatic payload compensation facility for the single-axle air suspension did not permit driver control. The driver could not actively control the system to make it easier to enter and exit or load the vehicle.
Ride level was compensated via the rear axle only.

Advantages of the new system

The new system allows the ride-height control system to be controlled actively by the driver.
The twin axle air suspension allows both axles to be lowered evenly and in parallel.
As a result, it is easier for the occupants to enter, exit, load and unload the vehicle.

History

BMW previously supplied ride-height control systems as both optional equipment and, in part, as standard equipment on the 7 Series - E23/E32(not in the US market), 6 Series - E24 (L6/M6) and 5 Series - E28 (M5). On the E39, the load of the complete rear axle was born for the first time by air suspension in combination with the optional ride height control system. The system was controlled automatically under all operation conditions, and there was no possibility for driver intervention on the X5, the rear axle previously had single axle air suspension only. The air supply unit and the control unit were adopted from the E39. The air springs were adapted to the X5.

There is a standard version and a sports version.

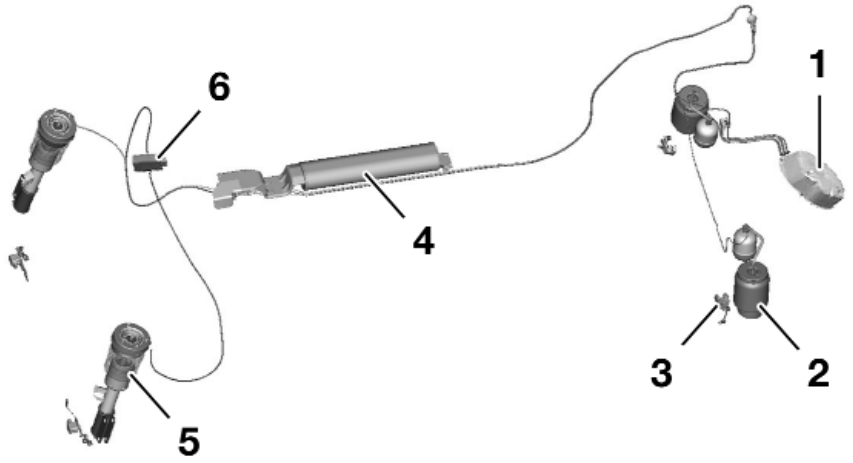
The ride-height control system (EHC) was supplied as standard in combination with the M62 engine and is available as an optional extra in combination with the M54 engine.

EHC2 is optional on both the M62 and M54 versions of the X5 and not available on the 4.6is X5.

System components

The X5 Two Axle Air Suspension System (EHC2) utilizes the air supply unit from EHC mounted in the luggage compartment, with the following components added or modified:

- Air Supply Unit (with redesigned compressor and drier)
- Pressure Accumulator
- Valve Unit
- Ride Height Sensor
- Air Suspension Strut
- Control Unit
- Switch Assembly



1. Air Supply Unit
2. Rear Axle Air Bellows
3. Ride Height Sensors
4. Pressure Accumulator/ Valve Unit
5. Front Axle Air Bellows
6. Control Unit

Pneumatic System of EHC2

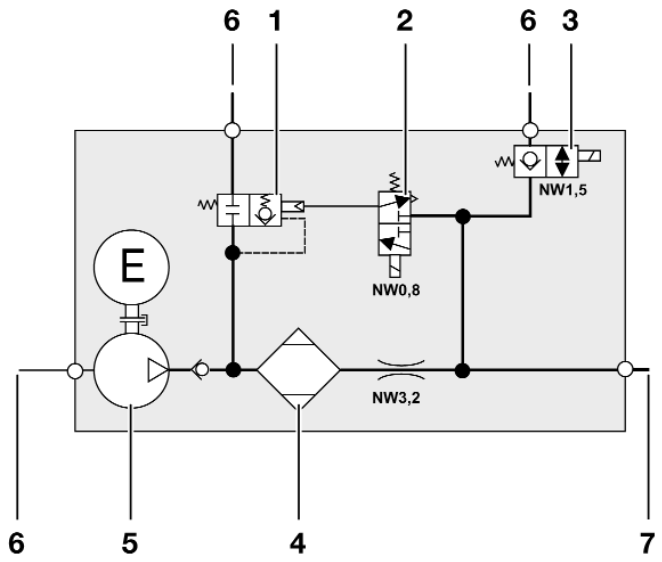
Air Supply Unit

As on vehicles with single axle air suspension, the air supply unit is located in the luggage compartment under the spare wheel. As with the single axle air suspension, the auxiliary tanks for the rear air spring bellows are located in the luggage compartment.

The air supply unit is configured similarly to the single axle air supply unit for the ride-height control system of the E39, which is currently in production.

The functions are implemented by activating a compressor and various valves in the air supply unit and on the air accumulator valve unit.

The maximum pressure of the air supply unit is 21 bar.



1. Pneumatic Drain Valve
2. Electric Pilot Control Valve
3. High Pressure Vent Valve
4. Air Drier
5. Compressor
6. Sintered filter
7. To Pressure Accumulator/Valve Unit

NW Size of opening/tubing in mm.

Air Supply Unit

Pneumatic Drain Valve

The Pneumatic Drain Valve is activated pneumatically by pressure from the control valve. This causes the drain valve to open allowing the pressure supply line to vent to atmosphere. This design allows for large air volumes to be discharged quickly and eliminates the need for a solenoid valve with high current consumption.
The 21 bar pressure limiting valve is integrated in the drain valve.

Electric Pressure Relief Valve

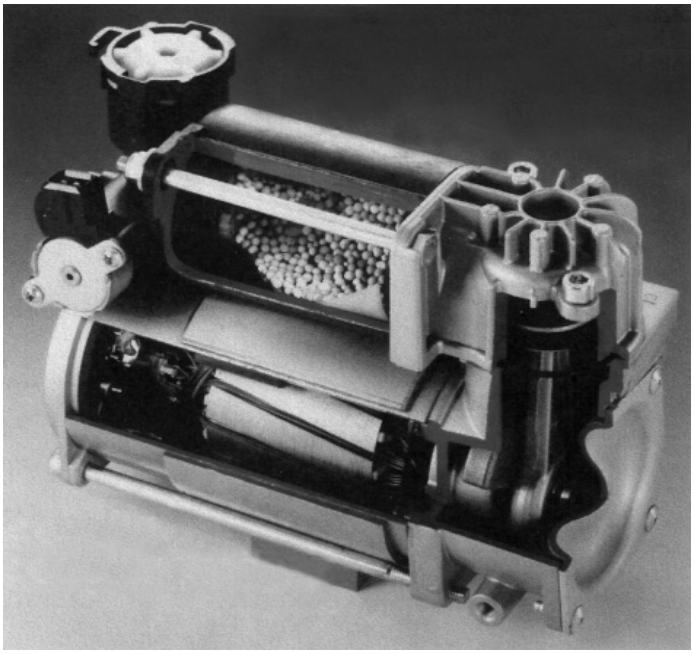
The electrically activated pressure relief valve controls normal system pressure. The control valve performs this function in conjunction with the drain valve.

HIgh Pressure Vent Valve

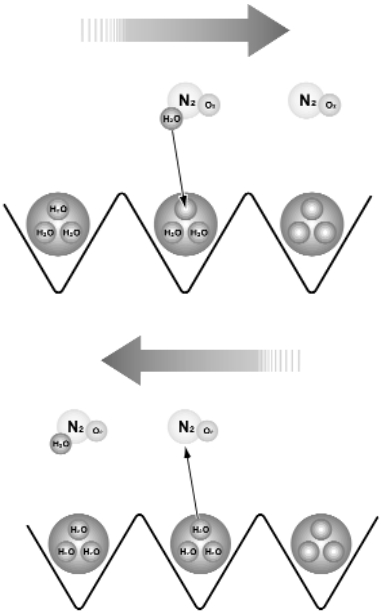
The High Pressure Vent Valve serves as a comfort valve and is used to release system pressure after the accumulator has closed and the compressor is still running. When the high pressure vent valve has opened the compressor can be stopped quietly.

Air Drier

In the air drier, the air which is drawn in passes over a water absorptive filter material in the form of filter nodules which extract moisture from the air. As long as the air contains more moisture than the filter material, the individual nodules absorb and accumulate the moisture. When the air flows back, it is drier than the filter material, with the result that the air is re-humidified and the moisture is discharged into the open air. The maximum water storage capacity of the filter is 30 g.



Compressor with Drier



Top: Air Drying
Bottom: Dissipation of water to air

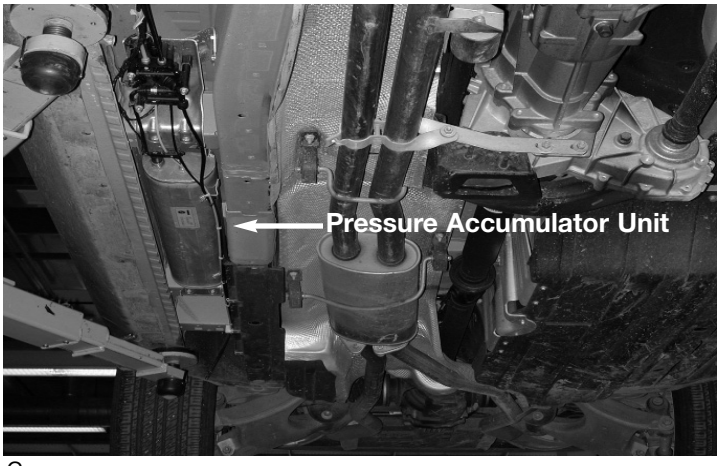
Compressor

Compressor operation is the same as in EHC with the following technical improvements:

- Addition of a temperature sensor (Located on the compressor cylinder head) Temperature sensor switches off the compressor at temperatures above 110°C.
- Extended compressor ON time (180 seconds)
- Redesigned air drier to compensate for additional air volume.

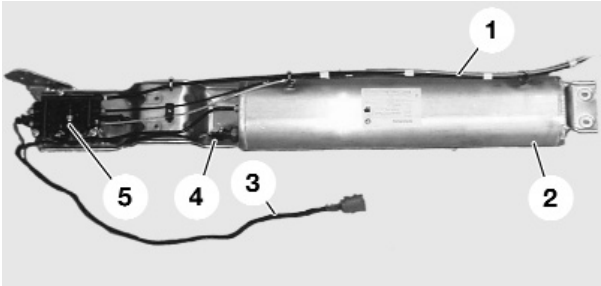
Pressure Accumulator

The twin axle air suspension system now features a pressure accumulator which forms an air accumulator valve unit in combination with the valve. The air accumulator valve unit is located beneath the vehicle floorpan in the right-hand sill area.

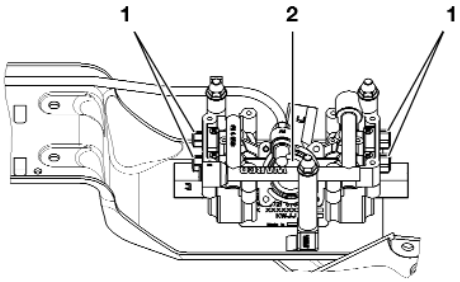


Pressure Accumulator Unit which includes:
Pressure Accumulator
Pressure Sensor
Valve Unit

The pressure accumulator decreases the load on the compressor and significantly reduces the time required for large changes in ride height.
The EHC 2 control module monitors system pressure via a pressure sensor mounted on the accumulator. Normal system pressure is 15.7 +/- 0.7 bar. Minimum system pressure is 9 bar.
The pressure accumulator's charge is sufficient to fill the four suspension struts once from the Access position to the normal position and compensate for vehicle load up to maximum gross weight.



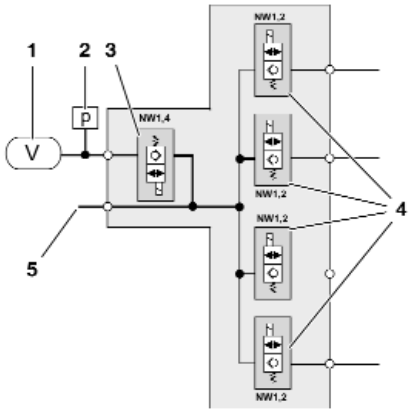
Accumulator/Valve Unit
1. Air Lines
   Yellow-Black Front
   Red-Blue Rear
2. Pressure Accumulator
3. Connecting Cable
4. Pressure Sensor
5. Valve Unit

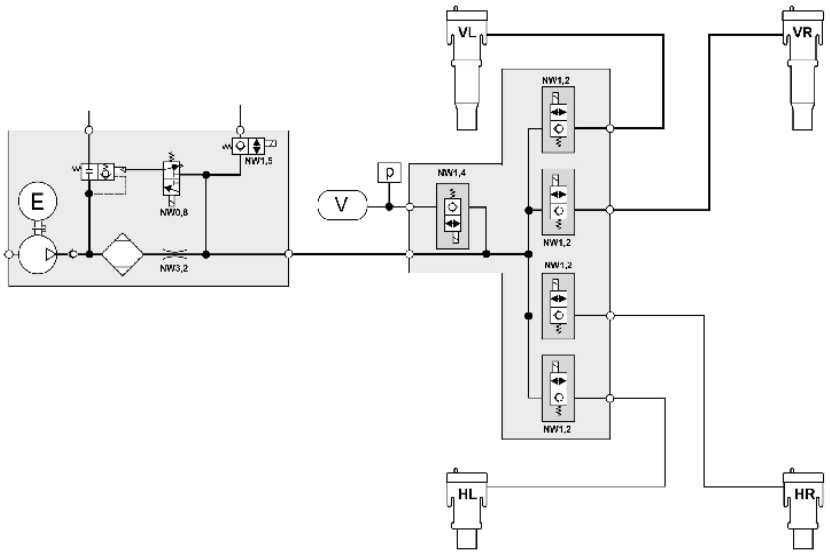


Valve Unit
1. Connections for Air Lines
2. Pressure Accumulator valve

Valve Unit

In the valve unit, four bellows valves and the pressure accumulator valve are activated.
The bellows valves and the pressure accumulator valve are solenoid valves which are closed under spring pressure when de-energized.



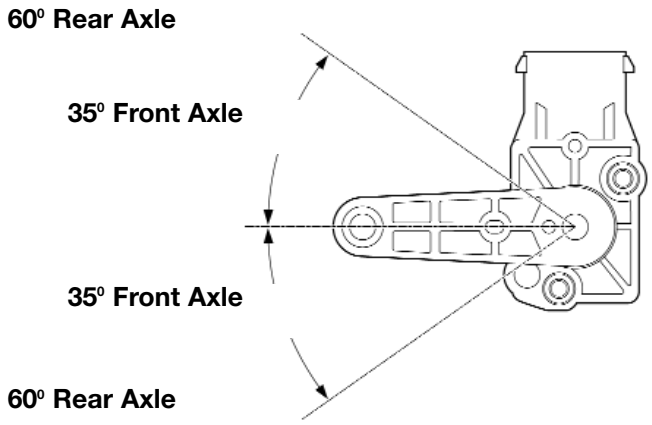


Pneumatic Layout of Control Valve
1. Pressure Accumulator
2. Accumulator Pressure Sensor
3. Pressure Accumulator Valve
4. Bellows Valves
5. From the Air Supply Unit

NW Size of opening/tubing size in mm.

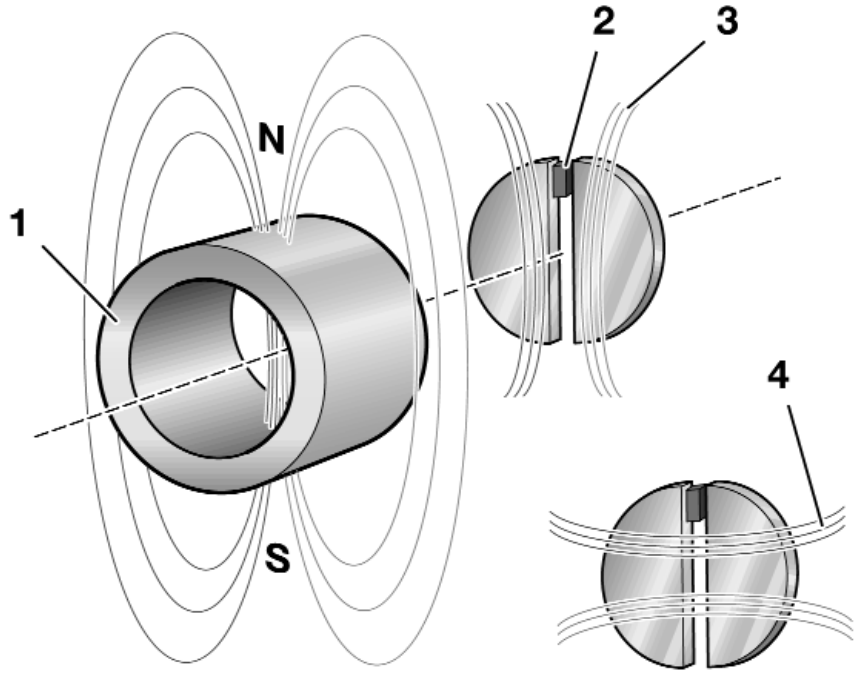
Ride Height Sensor

The control unit obtains information about the ride height of the vehicle via a ride height sensor attached to each of the four wheels.



Ride Height Sensor

The ride height sensor is an angle Hall sensor which is activated by a ring magnet. The ring magnet is polarized vertically from north to south.
The magnetic field line of the ring magnets intersect a Hall cell. The Hall cell is arranged in such a way that only the horizontal components of the field lines are evaluated. This results in different field line strengths at different positions of the ring magnet. The Hall cell measures the field strength of the magnetic flux and converts it into an analog signal with a voltage level between 0.5 and 4.5 V.



Sensor Principle of Operation

1. Ring Magnet
2. Hall Cell
3. Longitudinal magnetic field lines, low voltage 0.5V
4. Transverse magnetic field lines, high voltage 4.5V

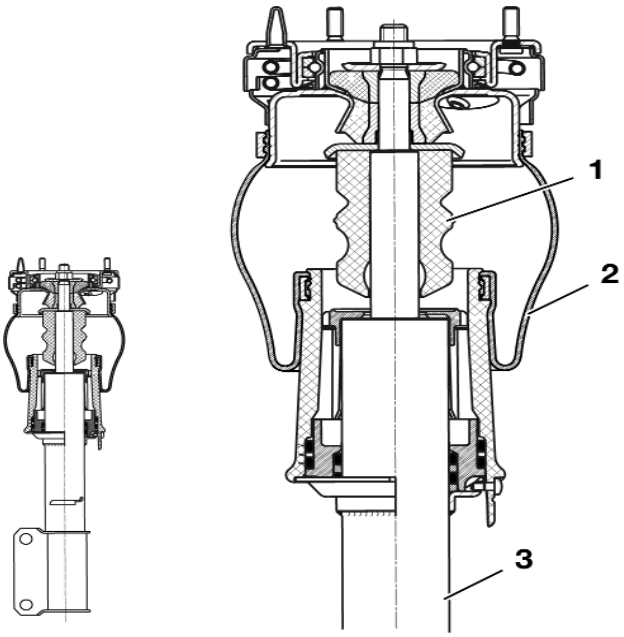
Air Suspension Strut

Rear

Minor modifications were made to the rear axle air springs. The air springs and the dampers are configured separately at the rear axle.

Front

The air suspension replaces the steel suspension at the front axle, i.e. the spring bellows is attached to the damper. The front air suspension strut and the impact absorber form a complete unit.



Air Suspension Strut
1. Auxiliary Spring
2. Air Bellows
3. Damper

Control Unit

The EHC2 Control Unit is located behind the glovebox adjacent to the General Module. The connector is a black 54 pin connector.
Inputs received directly into the control unit are:

Ride Height Level Sensor (X4)
General Module (Load cutout signal)
K Bus Inputs
Compressor Temperature
Up and Down requests from the switch assy.
CAN Bus Inputs
Pressure Sensor

Outputs include:

Air Unit Control (Activation)
LED's for Switch Unit
Pressure Accumulator
Front and Rear Axle Valves
Compressor Relay

Switch Assembly

The dash mounted switch assembly supplies a momentary switched ground to the EHC2 Control Unit requesting a ride height change in the up or down direction. Three LED's provide current ride level selected and target ride level if a request for change has been made. The LED for the current ride height will always be illuminated. The LED for the target ride level will flash until the new ride level is reached.

Notes:

Principle of Operation

Ride Height Control Operations

In addition to the automatic ride-height control system for payload compensation, the driver can set three different vehicle ride heights.

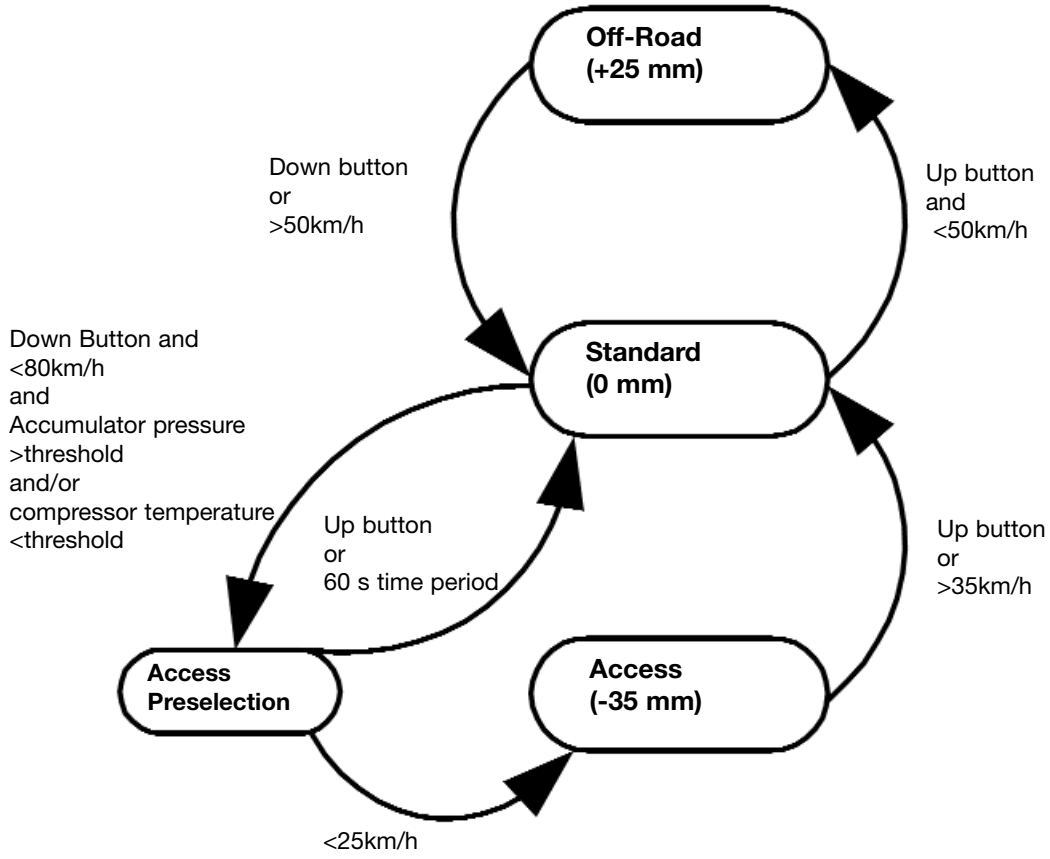
- Off-road (+25 mm), high ground clearance to a max. speed of 50 km/h
- Standard (0 mm), normal ride level
- Access (-35 mm), for entry and exit, loading and unloading to a max. speed of 35 km/h or can be activated in Standard mode at road speeds < 25 km/h

The various heights are selected by scroll rocker. Light emitting diodes indicate the present ride height setting.
Ride height can be adjusted from terminal 15 and with the doors closed. The hood and tailgate may be open.

The system also controls inclination automatically, like the single axle air suspension.

All control operations are executed without stopping at intermediate levels. The vehicle is configured pneumatically in such a way that the front and rear axles can be lowered in parallel in any load situation. Depending on the load situation, either the front axle or the rear axle is slightly quicker. On account of the different control speeds, a difference in height between the two axles is possible during all control operations. If a max. permissible threshold is exceeded, the quicker axle is stopped briefly.

The various levels can be preselected while travelling. Changeover between ride levels is effected at the speed threshold values defined in the control unit. The control unit monitors the change-over.
As soon as the driver sets a new target ride level by pressing a button or when a changeover is initiated automatically by a specific driving condition, the LED for the current ride level remains lit and the LED for the target ride level begins to flash.
When the new level is reached, the LED for the previous level goes out and the LED for the new level reached stays lit permanently.



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When the new level is reached, the LED for the previous level goes out and the LED for the new level reached stays lit permanently.

If a ride level selection is not allowed, the LED indicating the momentary ride level of the vehicle flashes for 3 seconds.

A special case is preselection of Access levels while travelling. The Access LED flashes and the LED for the original ride level is lit permanently. However, this does not mean that a control operation has already begun. The control operation does not actually begin until the speed threshold which the Access level allows is reached or undershot.

In addition to the LED indicator, the following text messages can be displayed in the instrument cluster:

- *TRAILER MODE*
  A coupled trailer is identified via the trailer connector. To avoid damaging the trailer and the vehicle, changes of vehicle level are generally avoided. The standard level is "frozen." If the trailer is coupled at a level other than the Standard level, the vehicle ride level is not changed to Standard unless a button is pressed or the speed threshold for automatic change-over is reached. The standard level is then "frozen" until the trailer connector is disconnected.
- *RIDE HEIGHT CONTROL INACTIVE*
  Faults in the system and on the control unit which are only identified by the instrument cluster, e.g. control unit disconnected
- *RIDE HEIGHT CONTROL INACTIVE + MAX. 60 km/h*
  For safety-critical faults (vehicle is too high or at inclination)

Control Modes

Sleep mode
If the vehicle is parked, it enters Sleep mode after 16 minutes. No further control operations are executed. A "watch dog" wakes up the control unit for a few minutes every 6 hours (wakeup mode) in order to compensate for possible inclination of the vehicle. (Vehicle height may only be corrected once as air supply unit only operates with engine running.)

Wake-up
In wake-up mode, the control unit is woken up for a set period of time in order to compensate for possible inclination of the vehicle. Inclination of the vehicle can be caused by large temperature differences or by minor leaks. Adjustments to the front and rear axles ensure that the vehicle is visually level. To minimize power consumption, the vehicle is lowered only. The nominal level of the lowest wheel serves as the nominal level for all other wheels. The lowest nominal level to which the vehicle is lowered is the Access level (-35 mm).
Exception: if the vehicle is parked at Access level, the vehicle is lowered to max. -50 mm in wake-up mode. If the vehicle is parked for a prolonged period of time and there is a leak in the system, further loss of pressure does not produce a change of ride level since the weight of the body is born by the auxiliary suspension and the residual tire pressure.

Advance /Overrun
When the vehicle is woken out of sleep mode by the load-cutout signal (VA), it normally enters advance / overrun mode. Since the engine is not (no longer) running in this mode, however, there are restrictions on the control operations that can be performed in order to conserve the battery. Ride level compensation is restricted to tolerance ranges of 20 mm and 25 mm in the up and down directions respectively. This serves to reduce the frequency of control operations.

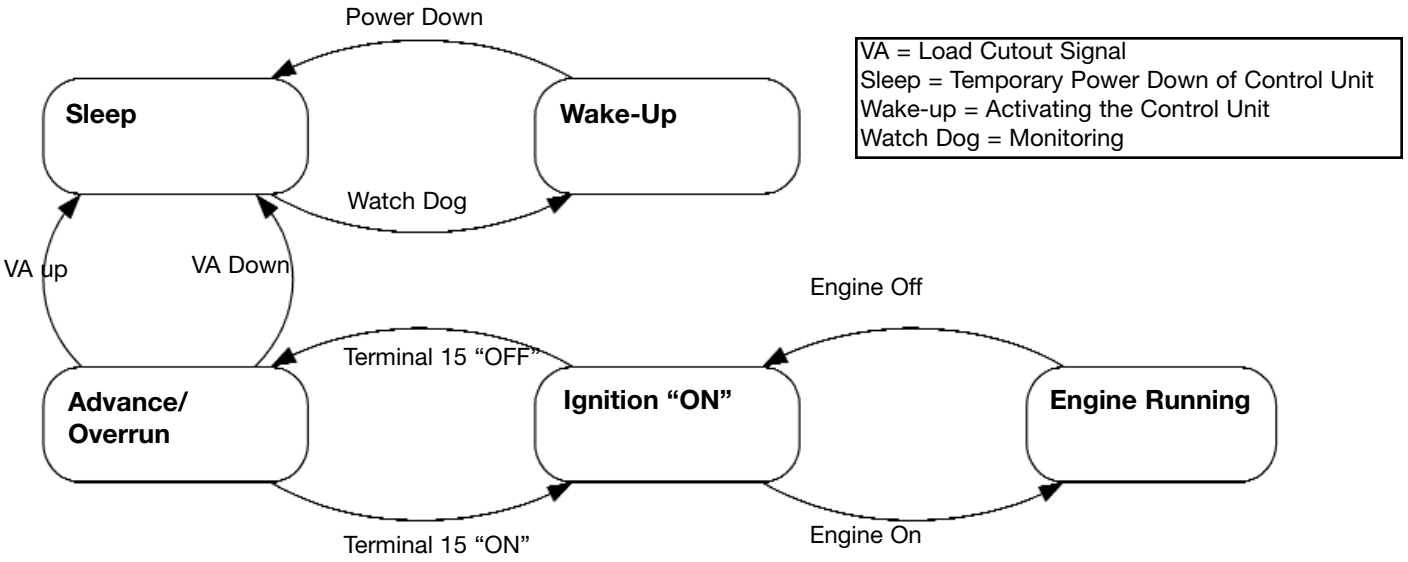
All control operations in advance / overrun mode are executed as long as pressure is available in the accumulator. When the accumulator is empty and the engine is turned off, control operations are directly driven by the compressor. User-activated changes of ride level and filling of the accumulator are not possible.

Terminal 15

As soon as the ignition is turned on (terminal 15), the user is allowed to lower the ride level as required.
However, it is still not possible to raise the ride level or fill the accumulator.
Ride level is compensated outside a narrow tolerance range of 10 mm upwards and 10 mm downwards.

Engine "on"

Ride level compensation, raising and lowering the vehicle's ride height as well as filling the accumulator are permitted when the engine is running. The compressor also starts up during every control operation.
Ride level is still compensated outside the narrow tolerance range of ±10 mm.
As long as the vehicle is stationary, high speed filtered ride level signals are used to detect a change of load. This allows the system to react immediately to changes in ride level.
As soon as the vehicle is travelling, it changes over to low speed filtered ride-level signals. The system no longer reacts to bump movements caused by road surface unevenness. A mean value is formed over a prolonged period of time, i.e. payload is only altered by the progressive emptying of the fuel tank.
The high speed filter is not used until the vehicle is stationary again and a lid is opened. If no lid is opened, the vehicle logically cannot be loaded or unloaded.



Workshop Hints

If a threshold level is exceeded on all 4 wheels when the vehicle is stationary, the control unit assumes that the vehicle has been raised on a workshop platform.
There are three possible reset conditions for workshop platform recognition:

- The original level values are undershot at all four wheels,
- A selection is made by button,
- A speed of >40 km/h is recognized for 3 s.

Vehicle jack

If the lowering speed at a wheel is too low during the lowering operation, the system assumes that the wheel is jacked up. However, the downward velocity must be less than a certain preprogrammed speed threshold. If the system detects a jacked wheel, it stores the height of this wheel.
Car jack recognition is reset when the stored ride height is again undershot. When a travelling speed of 40 km/h is maintained for at least 3 s, another control attempt is performed. The car jack recognition can also be reset by button selection.

Please note that the system also controls ride height in diagnostic mode. For this reason, Belt Mode must be activated before carrying out work on the system or before setting the vehicle ride height.
Belt Mode:
Heights are fixed and are not compensated. If Belt Mode is set, the function LED is off. The text message "ride-height control system inactive" appears in the instrument cluster.
Transport Mode:
The Transport Mode setting is for transportation purposes. When the ignition is turned on, the message "ride-height control system inactive" appears. Heights are increased or decreased depending on ignition key status, e.g. ride height is reduced when the vehicle is lashed to a ship or train and raised when the "Engine on" signal is generated and when the vehicle is transported on a transporter truck.

The correct ride height is set to ± 5 mm via "Activate components." The left and right ride levels are set separately at the rear axle. The ride levels are then set at the front axle. The left and right air springs are adjusted jointly for this purpose.
Following this, the new ride height for the front and rear axles is stored via the "Offset function."
Before replacing components, the system must be depressurized! This is done in the diagnostics via "control unit functions," "Component activation," "Pressure-relieve front axle/rear axle." Repeat the activation procedure 6 times.

If the fabric of the bellows is visible, then the bellows must be replaced.

Upon completion of repair work, the air suspension system of the vehicle raised on the workshop platform must be refilled with air via the diagnostics. The activation procedures must also be repeated 6 times. This prevents the bellows from being folded incorrectly.
The vehicle must with be set down on its wheels when the suspension struts are depressurized!

Important Workshop Hint
Similarly, a defective vehicle with leaky pneumatic system must not be raised on the workshop platform. If depressurized, the bellows would contract under suction forming incorrect folds. These folds could result in malfunctions later on.

Areas on the air bellows which can possibly become leaky are the O-ring at the piston rod and the seal carrier on the roll piston.
The connectors attached to all cables are identical to the connections on the single-axle air suspension. 6 mm cable is used. The tightening torque is 3 ± 1 Nm throughout the system. Special care must be taken when handling breakage-prone plastic parts of air suspension elements.
Upon completion of repair work, Belt mode must be deactivated via the diagnostics. The function LED on the button comes on. No text message appears in the instrument cluster. The system is OK and ready for operation.

X5 4.6 iS

The X5 4.6iS is an additional model added to the X5 family of SAV's. The 4.6 receives model code FB93/0266 and is available start of production 10/01.

Features added to the 4.6 versus the 4.4:

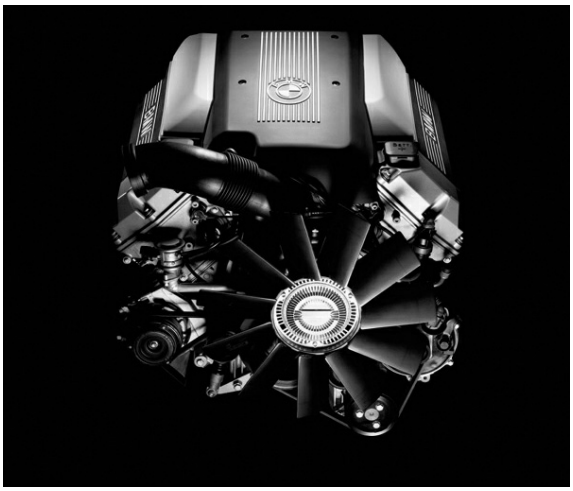
- Increased Engine Displacement/Horsepower
- Increased Transmission Capacity
- Upgraded Brakes
- Additional Standard Features
- Special/Limited Exterior Colors
- New Interior Textures

Engine

The engine for X5 4.6iS is a M62 with increased displacement and horsepower.

	M62 4.6	**M62 4.4**
Displacement (cm^3)	4619	4398
Bore (mm)	93.0	92.0
Stroke (mm)	85.0	82.7
Compression Ratio	10.5:1	10.0:1
Maximum Horsepower@RPM	340 @ 5700	290 @ 5400
Maximum Torque (NM)@RPM	475 @ 3700	440 @ 3600
Engine Management System	ME7.2	ME7.2
Emission Compliancy	LEV	LEV
Performance 0-60 mph	6.2 Seconds	7.4 Seconds

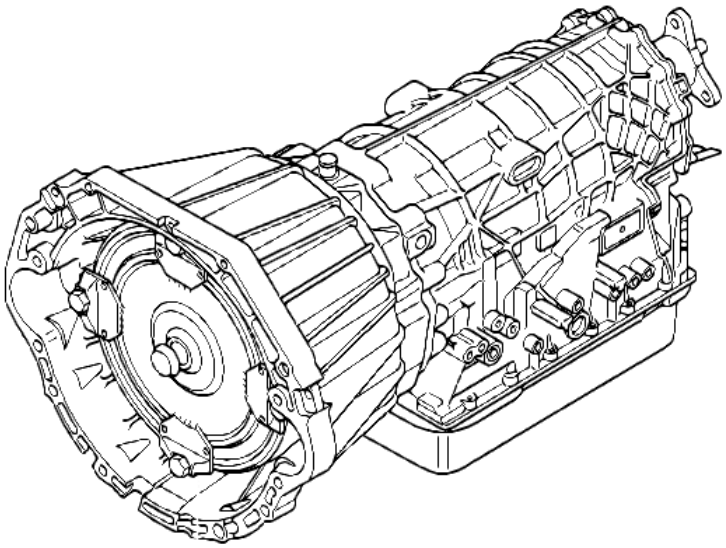
Diagnostics of the 4.6iS are carried out in the same manner as the X5 4.4.



X5 4.6iS

Transmission

The X5 4.6iS is available only with a ZF A5S 440Z 5-speed automatic transmission which features modified internal components. Many internal components, including the torque convertor have been modified to handle the increased torque and horsepower.
The transmission is specific to the X5 4.6iS and no other transmission should be substituted.
Programming of the transmission is also changed to better accommodate the vehicle.
Transmission management will be by EGS 8.60.2.
Transmission diagnostics will be handled in the same manner as other models.



Brakes

Front and rear brakes are upgraded on the X5 4.6iS.
Brake rotor size is increased from the 13.1 in. front normally found on the X5 4.4 to a size of 14.0 in. on the 4.6iS.
While rear brake rotor diameter remains the same on the 4.6iS at 12.8 in., the thickness of the rotor is increased and the rear rotor is now ventilated similar to the front rotor.

With these changes brake calipers, brake rotors and brake pads for both front and rear are vehicle specific for the X5 4.6 and similar components from other models may not be interchanged.

Additional Standard Features

The following equipment is added to the 4.4 model equipment for the X5 4.6iS:

Glass Moonroof	Roller Sun Blinds For Rear Doors
Self Dimming Mirrors	Rear Seat Back Adjustment
Rear Seat Heating	PDC
Rain Sensor	Premium Sound System
CD Changer	Privacy Glass

Colors

Special colors and combinations along with special interior packages are available. Refer to marketing information for current availabilities.

Review Questions

1. List the advantages of the EHC2 over EHC as used in the X5.

2. What component is responsible for limiting the maximum pressure in the EHC2? And what is the maximum pressure/minimum pressure?

3. Why is a pressure accumulator used?

4. The control unit for EHC2 is located ?

5. List the possible ride heights possible with EHC2.

6. If the driver fails to return the system to the standard position what happens as the X5 goes down the road.

7. What causes the control unit to assume the vehicle is being raised on a platform in the workshop?

8. Why is it important not to raise a vehicle with a leaky pneumatic system?

9. How do the front and rear brakes of the 4.6 is compare with the 4.4.

10. Is it possible to interchange transmissions from a 4.6 to a 4.4?